SECTION 13

QUALITY CONTROL REQUIREMENTS

13.1 The QC checks that are needed are determined by the project QA objectives and the anticipated uses of the results. QC checks apply to field activities, laboratory activities, and the data analysis.

13.2 Field activity QC checks should include:

- collection of replicate samples at various stations (usually 10 percent of total number of samples collected Section 10.9.2 and Table 10-1) to assess the consistency of the collection effort;

- repeat (and/or parallel) field collections and analyses performed by separate field crews to provide support for the bioassessment (Table 10-1);

- occasional alternating and mixing of field personnel to maintain objectivity (minimize individual bias) in the bioassessment; and

- in visual-based physical habitat assessment, final conclusions are potentially subject to variability among investigators. This limitation can be minimized, however, by ensuring that each investigator is appropriately trained in the evaluation technique and periodic cross-checks are conducted among investigators to promote consistency. Consistency among parallel and independent physical habitat assessments can be evaluated by rank order comparisons of the evaluated sites. Thus, comparing the score for each parameter is not as important as comparing the total score for each habitat assessment which gives the rank order of sites (their placement in the assessment from good to bad).

13.3 Laboratory activity QC checks should include:

- Periodic sorting checks of samples to uphold a minimum established, at least 90 percent, percent recovery error to maintain sample processing and sorting efficiency. When the established percent recovery error is not met, then an appropriate number of samples should be re-checked until the percent recovery error is within accepted limits.

- A record of all samples sorted along with a list of QC checks should be maintained to document the QC process for the samples.

- Taxonomists, who are identifying organisms, should have adequate taxonomic references to perform the level of identification required. These references should be on file at the laboratory so that periodic checks can be made to facilitate obtaining new references or updating existing references needed for the identification of specimens to the lowest taxonomic level possible.

- Representative specimens of all taxa identified should be checked and verified by a specialist in that particular taxonomic group. These specimens should be properly labelled as reference or voucher specimens (including the name of the verifying authority), permanently preserved, and stored in the laboratory for future reference.

13.4 Data management QC checks should include:

- hard copies of all computer-entered data should be reviewed by the data entry personnel by direct (side-by-side) comparison with the field or laboratory handwritten data sheets.

13.5 Data analysis QC checks should include the following:

- Periodic checks by trained staff or peer review throughout the data analysis process. Data validation and verification QC checks include examination of outliers, total numbers, odd numbers, and unusual species. Errors can occur if inappropriate statistics are used to analyze the data.

- Transcription error and a poor presentation can occur if care is not taken to provide adequate training and appropriate review. QC checking of data reports by peer review, the use of a technical editor, and following a standard format will help to ensure complete and relevant data analyses and reporting.

SECTION 14

INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

14.1 To help ensure collection of consistently high-quality data, a plan of routine inspection and preventive maintenance should be developed for all field and laboratory equipment and facilities. The following types of preventive maintenance items should be considered and addressed in the QAPP:

- a schedule of important preventive maintenance tasks that must be carried out to minimize downtime in the field and laboratory should be kept;
- a list of any critical spare parts that must be on hand to minimize downtime in the field and laboratory (Section 15.3) should be included;
- personnel whose duties include operation of specific pieces of sampling gear or detection instruments should have primary responsibility for inspection of such equipment;
- personnel should be assigned responsibility for locating and gathering of all necessary field equipment at least 24 hours in advance of departure to sampling stations.

14.2 Example equipment and supply lists for benthic macroinvertebrates and fish are presented (Tables 14-1, 14-2).

TABLE 14-1 Example of equipment and supply list for benthic macroinvertebrate sampling (Plafkin et al. 1989).

1. Square meter kicknet, standard no. 30 mesh (595 μm openings) (including pole attachments)
2. Additional kicknet, as backup
3. Sample containers, two-three 1-liter, plastic, opaque, straight-sided, w/screw tops (per station)
4. Maps of site location and access routes
5. Two internal labels (per station)
6. 12 Pencils, no. 2 soft lead
7. Grease pencils, two-three (per trip)
8. Scissors, one pair
9. Forceps, three or four pair
10. Gridded screen subsampling equipment (Caton 1991)
11. Wash bottle, 1-liter capacity
12. Sieve bucket, standard no. 30 mesh (595 μm openings) (Wildco cat. no. 90)
13. Two 1-gallon buckets (plastic)
14. One clipboard
15. 95 percent ethanol, or 10 percent formalin; 0.5 gallon per station (container should be appropriate for pouring into sample containers w/minimum spillage)
16. Funnel
17. Hip waders, one per crew member
18. Log book (bound)/Field notebook
19. Data sheets (may be rite-in-rain) or PDR
20. Box or cooler for sample transport
21. Dice for random numbers determination
22. First aid kit
23. Rubber gloves, heavy gloves
24. Rain gear for each person
25. Waterproof tape
26. Compass
27. Kim wipes in ziplock bags
28. Watch with timer or stop watch
29. Camera
30. Patch kit for waders

TABLE 14-2 Example of equipment list for fish sampling in wadable streams.

1. Backpack electrofisher
2. Spare batteries (or gasoline) and spare electrofisher if distant from base
3. Insulated rubber gloves, one pair per person
4. Waders, hip or chest, one pair per person
5. Long-handled nets, two
6. Plastic buckets, three or four 1-5 gallon capacity
7. Block nets, two 20 meters in length
8. Measuring tape, 100 meter
9. Fish measuring board (length)
10. Weight scales
11. Clipboard
12. Data sheets (may be rite-in-rain) or PDR
13. 12 Pencils, no. 2 soft lead
14. Ear plugs (if gasoline generator)
15. Patch kit for waders
16. Fish field guide
17. Anesthesia (MS-222)
18. Plastic collection jars with tight fitting lids (multiple sizes)
19. Electricians tape
20. Labels
21. Preservative (formaldehyde or isopropyl alcohol)
22. Probe
23. Calipers
24. Stopwatch with timer
25. Small dip net
26. White enamel pan
27. Conductivity pen
28. Camera

SECTION 15

INSTRUMENT CALIBRATION AND FREQUENCY

15.1 The purpose of this section is to document detailed description or reference of the appropriate SOPs for assuring that field and laboratory equipment are functioning optimally. Instruments used for measuring water quality, current velocity, or any other measurable parameters should be calibrated with certified equipment and/or standards (with known, valid relationships to nationally recognized performance standards) prior to gathering data at each sample location. In the absence of nationally recognized standards, documentation for the basis of the calibration is needed. Permanent records with dates and details of these calibrations and checks must be maintained. Documentation is necessary to identify each specific measuring device, where and when it is used, what maintenance was performed, and the dates and steps used in instrument calibration. This information should be traceable to each instrument. Definition should be given for the acceptance criteria for all calibration measurements. All field measurements should be accompanied by documentation of the type of instrument and the identification number of the instrument used.

15.2 For biological field equipment, there should be routine procedures to ensure that equipment is appropriate for the needed sample and is in proper working order. For example, for benthic macroinvertebrates and algal collections using artificial or introduced substrata should have confirmation of surface area. Multiplate samplers (e.g., Hester-Dendy), should have the number, area, and thickness of plates and spacing dividers confirmed and documented prior to departure from storage. Rock baskets (introduced substrate) should have the surface area of the rocks confirmed and documented prior to departure from storage. For benthic macroinvertebrate net collections, there should be measurement of the device dimensions and knowledge of size of mesh net openings. There should also be effort toward repairing holes or replacing nets.

Zooplankton and phytoplankton pumps, traps, and nets should be checked for proper working order and size of mesh net openings; hand collection gear, bottles, knives, and droppers should be clean and in good working order.

For fish (electrofishers) there should be consistent checks of voltage, amperage, wattage, and field pattern in the context of conductivity. Calibration of electrical instruments should occur at each sampling site. Confirmation and notation of condition for proper biological sampling gear should be at least 24 hours prior to scheduled departure for fieldwork.

15.3 For biological field gear, there are several components that need to be checked initially and then prior to fieldwork. When gear is constructed or received

from the manufacturer, initial documentation of equipment specifications should be recorded. For example,

- gear dimensions
- gear specifications
- gear condition
- net dimensions
- mesh size
- appropriateness of gear for study objectives.

Prior to each field effort, gear should be checked. For example,

- gear condition
- working order
- spare parts
- repair kits
- extra units.

15.4 In essence, taxonomic identification performance is partly accomplished by ensuring use of the most current technical taxonomic literature, by development and use of an appropriate reference collection, and by use of an expert taxonomist (Sections 12.6, 12.7).

SECTION 16

INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

16.1 Discuss how and by whom supplies and consumables, such as sample bottles, reagents, nets, etc., will be inspected and accepted for use in the project. Identify the acceptance criteria for such supplies in order to satisfy the technical and quality objectives of the project.

SECTION 17

DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

17.1 Identify the types of data that will likely be acquired from non-measurement sources such as computer databases, spreadsheets, and literature files; for example, metric calculations performed on a personally designed spreadsheet routine, identification of literature review for tolerance values, information from topographical maps, historical reviews, and raw data received electronically in addition to bench sheets from laboratories. Define acceptance criteria for the use of the data in the project. Discuss any limitations on the use of the data based on uncertainty in the quality of the data and explain the nature of that uncertainty. For instance, if raw data are entered electronically from laboratory bench sheets, each entry should then be confirmed.

SECTION 18

DATA MANAGEMENT

18.1 Outline the project data management scheme by tracing the path of the data through receipt from the field or laboratory to the use or storage of the final reported form. Describe the standard record keeping procedures, document control system, and the approach used for data storage and retrieval on electronic media. Explain the control mechanism for detecting and correcting paperwork errors and for preventing loss of data during data reduction, data reporting, and data entry to forms, reports and databases. Provide examples of any forms or checklists to be used.

18.2 Identify and describe all data handling equipment and procedures that will be used to process, compile, and analyze the data. This includes procedures for addressing data generated as part of the project as well as data from other sources. The specifications should include any required computer hardware and software and should address any specific performance requirements for the hardware/software configuration used. Describe the procedures that will be followed to demonstrate acceptability of the hardware/software configuration.

SECTION 19

ASSESSMENT AND RESPONSE ACTIONS

19.1 Identify the number, frequency, and type of activities needed to assess and evaluate the project. Assessments include system audits and performance audits which are part of every quality control program. Each QC plan must describe the internal and external performance and system audits required to monitor the capability and performance of the project.

19.2 A systems audit consists of a review of the total data production process which includes onsite reviews of the field and laboratory operational systems and facilities for sampling and processing of samples.

19.3 A performance audit is a type of audit in which the quantitative data generated (e.g., species enumeration and identification) is independently enumerated and identified. This type of audit can test accuracy.

19.4 To the extent possible, these audits should be conducted by individuals who are not directly involved in the measurement process. Audits serve three purposes:

1) to determine if a particular personnel or organizational group has the capability to conduct the monitoring before the project is initiated;

2) to verify that the QAPP and associated SOPs are being implemented; and

3) to detect and define problems so that immediate corrective action can begin.

19.5 The QAPP should specify who will conduct the audit, their relationship within the project organization or their independent affiliation, what the acceptance criteria will be, if or what type of audit will be used, and to whom the audit reports will go. A list should be prepared of the approximate schedule of activities and outline the information expected from the audit. The QAPP should also explicitly define under what conditions the assessor has the ability to order a work suspension.

19.6 The QAPP should explain how and by whom response actions to non-conforming conditions will be addressed, and identify the person(s) responsible for implementing the corrective action. The plan should also describe how corrective actions will be verified, validated, and documented. A corrective action program must have the capability to plan and implement measures to correct identified

problems, maintain documentation of the results of the corrective process, and continue the process until each problem is eliminated. The corrective action is the process to remediate defects.

19.7 Corrective actions may be initiated as a result of the following QA activities:

1) performance audits
2) systems audits
3) internal quality control checks.

19.8 When sampling or data analyses are shown to be unsatisfactory as a result of audits or QC sample analysis, a corrective action should be implemented. In addition, corrective actions should be taken during the course of sample and data analysis by field and laboratory crew when the routine QC check criteria are not met. The Project Manager, Laboratory Manager, Quality Assurance Manager, and support technicians may be involved in the corrective action. If data are affected by the situation requiring correction or if the corrective action will impact the project budget or schedule, the action should directly involve the Project Manager.

19.9 Corrective actions are of two basic kinds:

1) Immediate - the need for such an action will most frequently be identified by the field or laboratory technician as a result of calibration checks and QC sample analyses.

2) Long-Term - the need for such actions may be identified by audits. Examples of this type of action include:
   - staff training in technical skills or in implementing the QA/QC program
   - rescheduling of field, laboratory, data handling activities to ensure analysis within allowed holding times
   - reassessment of field and laboratory operation procedures and personnel.

19.10 For either immediate or long-term corrective actions, the following steps should be taken:

- Specify what type of conditions require corrective action.
- Define the specific problem.
- Assign responsibility for investigating the problem.
- Establish who initiates, approves, implements, evaluates, and reports corrective action.
- Investigate and determine the cause of the problem.
- Determine a corrective action to eliminate the problem.

- Assign and accept responsibility for implementing the corrective action.
- Establish effectiveness of the corrective action and implement the correction.
- Verify that the corrective action has eliminated the problem.

19.11 Internal auditing of field, laboratory, and data handling activities may result in the discovery of non-conforming procedures that, left uncorrected, could jeopardize the quality and integrity of project data and results. When such auditing is part of a project and a non-conformance is found, corrective action is initiated by documenting the finding and recommendations of the audit. The corrective action undertaken by the designated responsible party is documented with an implementation schedule and management approval. The implementation is verified by the auditor, which is then made part of the project audit report record.